

PATENT SPECIFICATION



789,481

Date of Application and filing Complete

Specification: December 1, 1955.

No. 34459/55

Application made in Germany on December 8, 1954

Complete Specification Published: January 22, 1958

Index at acceptance:—Class 2(5), R32(D1:D2:E8:G1), R33P.

International Classification:—C08g.

COMPLETE SPECIFICATION

Process for the Production of Foam Materials

I, JOHANN BAUER, of 67 Rosastrasse, Essen, Germany, a German citizen, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for the production of foam materials.

It is known that foam materials can be produced by the diisocyanate polyaddition process. The process was described by O. Bayer in *Angewandte Chemie*, 1947, pages 257 et seq, especially page 267 and is carried out today in practice on a large scale. The foam materials obtainable by the process generally have a density of approximately 30 to 70 kg. per cm.; their absorptivity is generally relatively low.

For many purposes it is desired to produce foam materials with modified properties. For example as good as possible an absorptivity is advantageous for sponges for household use or for washing motorcars and other articles. For other fields of use, a lower density or a softer structure is advantageous.

Hitherto attempts have been made to modify the properties of the foams by varying the composition of the starting materials or the conditions under which the foams were made.

It has now been found that foam materials with advantageous new properties can be produced by treating a synthetic polyurethane foam with an acid or alkaline reacting substance. During this treatment a part of the chemical substances contained in the foam goes into solution, which may be seen *inter alia* from the reduction in weight of the foam. If the foam is uniformly and thoroughly penetrated by the acid or alkaline treating bath, partial dissolution of the base materials takes place in such a way that, after a reduction in weight of the foam of approximately 10 to approximately 50%.

a material is obtained which still has a good foam structure but has more or less extensively modified properties as compared to the properties of the initial foam material, depending upon the degree of loss in weight.

Accordingly, the present invention provides a process for the production of soft and absorptive foam materials, wherein a synthetic polyurethane foam is treated with an alkaline or acid reacting agent until a reduction in weight of the foam of approximately 10 to approximately 50% of its original weight takes place. For example, the polyurethane can be produced by reacting a diisocyanate with a polyester or with a compound containing free hydroxyl groups such as butane-1,4-diol or hexane-1,6-diol.

The synthetic polyurethane foam materials contain ester, urethane, amide or urea groups, which are attacked or broken down by the acid or alkaline treating baths with an ease which is different for different foams. Moreover, the cells contained in the original foam materials are more or less extensively separated from one another by thin walls. It is to be assumed that the acid or alkaline treating baths preferentially attack those thin separating walls and thus loosen the structure of the foam bodies more or less extensively.

In accordance with a preferred embodiment of the process the effect of the acid or alkaline treating baths is intensified by subjecting the foam during the treatment with the acid or alkaline reacting agent to a mechanical treatment such that the foam is continuously compressed and again released. The rupture of the above-mentioned separating walls is promoted by this mechanical treatment.

The concentration of the acids or alkalies employed, the length of the treating time, the treatment temperature and the other conditions of the treating process can be so adjusted in relation to one another that the

loss in weight and the modification of the original properties are achieved to the desired extent for the foam used. Preferably alkalies and acids of low concentration are employed, because in this case the reaction can better be controlled by varying the reaction time and the reaction temperature. When for example sodium hydroxide solution is employed, concentrations of 10 to 20% have proved advantageous. When 10% sodium hydroxide solution is used the desired effects can be achieved either at room temperature with treatment times of 6 to 12 hours or at higher temperatures with correspondingly reduced treatment times. At temperatures of 70 to 80°C. a treatment time of a few minutes frequently suffices. When treating agents which have a weaker action are used, correspondingly more concentrated baths and/or longer treatment times and/or higher temperatures must be employed. The same applies to treatment with acids.

The carrying out of the treatment with the alkaline or acid baths is preferably followed by a neutralising and washing step in order completely to remove the alkaline or acid treating agents from the product after completion of the process.

In the first place, the process of the invention makes it possible to produce foams of lower density. By means of the process of the invention the density can be reduced for example to half the original density without deleteriously impairing the foam structure.

As a result of the reduction in weight the foam materials acquire a hitherto unachieved soft structure, which is very desirable for many purposes, for example for use in the production of bedding. The particular advantage of foam materials treated by the present process lies in the much improved absorptivity of the new foam materials. Probably the structure of the pores is altered in a fundamental manner by the treatment in accordance with the present invention. Sponges which have been treated in accordance with the present invention can for example take up to 30 times their weight of water. Sponges produced in accordance with the invention are very suitable for washing motorcars, windows and other articles. It is surprising that sponges produced in accordance with the invention can release the dirt which is taken up in sponges during use more rapidly than is the case with the initial sponges. In general, to make sponges obtainable in accordance with the present invention clean again, it is sufficient to wash them with clean water.

The permeability to air of sponges obtained in accordance with the invention is improved, which makes it possible to use them as air filters.

The handle of the sponges can be improved or made softer by carrying out an after-treatment with acetic acid. If the process is carried out as such with acid treating baths, it is advantageous first to carry out an intermediate treatment with an alkaline agent such as ammonia and thereafter to carry out an after-treatment with acetic acid or a volatile organic acid.

The extensibility or tear resistance is generally not reduced in spite of the above described treatment and in some cases is even improved. Moreover, as a result of the treatment in accordance with the invention the foam materials lose the unpleasant smell often possessed by foam materials.

The following examples illustrate the invention without limiting it to the embodiments which are contained in the Examples.

Example 1:

A foam material produced by reacting a diisocyanate such as hexamethylene diisocyanate with a polyester containing free hydroxyl groups, or with a compound containing free hydroxyl groups, such as butane-1,4-diol or hexane-1,6-diol, is treated for 5 to 10 minutes with 10% sodium hydroxide solution at a temperature of 70 to 80°C. The loss in weight is up to 50%. The product is carefully washed, if desired after a short treatment with acetic acid for the purposes of neutralisation. The foam obtained has a very good absorptivity and can be used for household articles, washing sponges and industrial sponges, for example in the ceramic industry. A similar effect can be achieved by carrying out the treatment with the 10% sodium hydroxide solution at room temperature for such a time that in this case also a loss of weight of about 50% is achieved.

Potassium hydroxide solution can be employed in place of sodium hydroxide solution with practically the same success.

Example 2:

A foam material produced by reacting a diisocyanate such as hexamethylene diisocyanate with a polyester containing free hydroxyl groups, or with a compound containing free hydroxyl groups, such as butane-1,4-diol or hexane-1,6-diol, is treated for 5 to 15 minutes at 80°C. with 20% barium hydroxide solution. Loss in weight is approximately 10 to 30%. Even with this smaller loss in weight the absorptivity is improved to a pronounced degree. The material is still similar to the initial product as regards softness of structure.

Example 3:

A foam material produced by reacting a diisocyanate such as hexamethylene diisocyanate with a polyester containing free hydroxyl groups, or with a compound containing free hydroxyl groups, such as butane-1,4-diol or hexane-1,6-diol, is treated

with a 30% sodium carbonate solution at temperatures of 80 to 90°C. for a period of 20 to 62 minutes. The loss in weight is 10 to 30%. A similar effect is achieved with

5 waterglass or sodium aluminate.

When 20% sodium sulphite is used, a temperature of 90°C. and a treatment time of several hours are required to achieve a loss in weight of more than 10%.

10 It is also possible to use ammonium chloride, ammonia urea, tri-sodium phosphate, thiosulphates, sodium sulphide, ethylene - diamine, dimethylamine, hexahydrodimethylaniline and other inorganic or

15 organic basic compounds.

Example 4:

A foam material produced by reacting a diisocyanate such as hexamethylene diisocyanate with a polyester containing free
20 hydroxyl groups, or with a compound containing free hydroxyl groups, such as butane-1,4-diol or hexane-1,6-diol, is treated with sulphuric acid of a concentration of 10 to 20%. During the treatment the foam is
25 continuously compressed and again released. When the foam material is treated with sulphuric acid of a concentration of 20% at a temperature of 95°C. for 6 minutes the loss in weight of the foam is about 40%. When
30 sulphuric acid of 20% concentration is used and the treatment is carried out at room temperature the loss in weight is 10% after about 4 days.

When a weak acid such as boric acid, a concentration of 30% and a reaction temperature of 90°C. were used, the loss in weight was about 10% after a treatment of 7-8 hours.

What I claim is:

1. A process for the production of soft and absorptive foam materials, wherein a synthetic polyurethane foam is treated with an alkaline or acid reacting agent until a reduction in weight of the foam of approximately 10 to approximately 50% of its original weight takes place. 40 45

2. A process as claimed in claim 1, wherein the treatment is carried out simultaneously with a mechanical treatment of the foam such that the foam is continuously compressed and again released. 50

3. A process for the production of soft and absorptive foam materials, substantially as described with reference to any of the Examples. 55

4. Soft and absorptive foam materials whenever produced by the process claimed in any of the preceding claims.

ELKINGTON & FIFE,

Consulting Chemists and
Chartered Patent Agents,

Bank Chambers, 329, High Holborn,
London, W.C.1.

Agents for the Applicant.

Berwick-upon-Tweed: Printed for Her Majesty's Stationery Office, by The Tweeddale Press Ltd.—1957.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2., from which copies may be obtained.

THIS PAGE BLANK (USPTO)